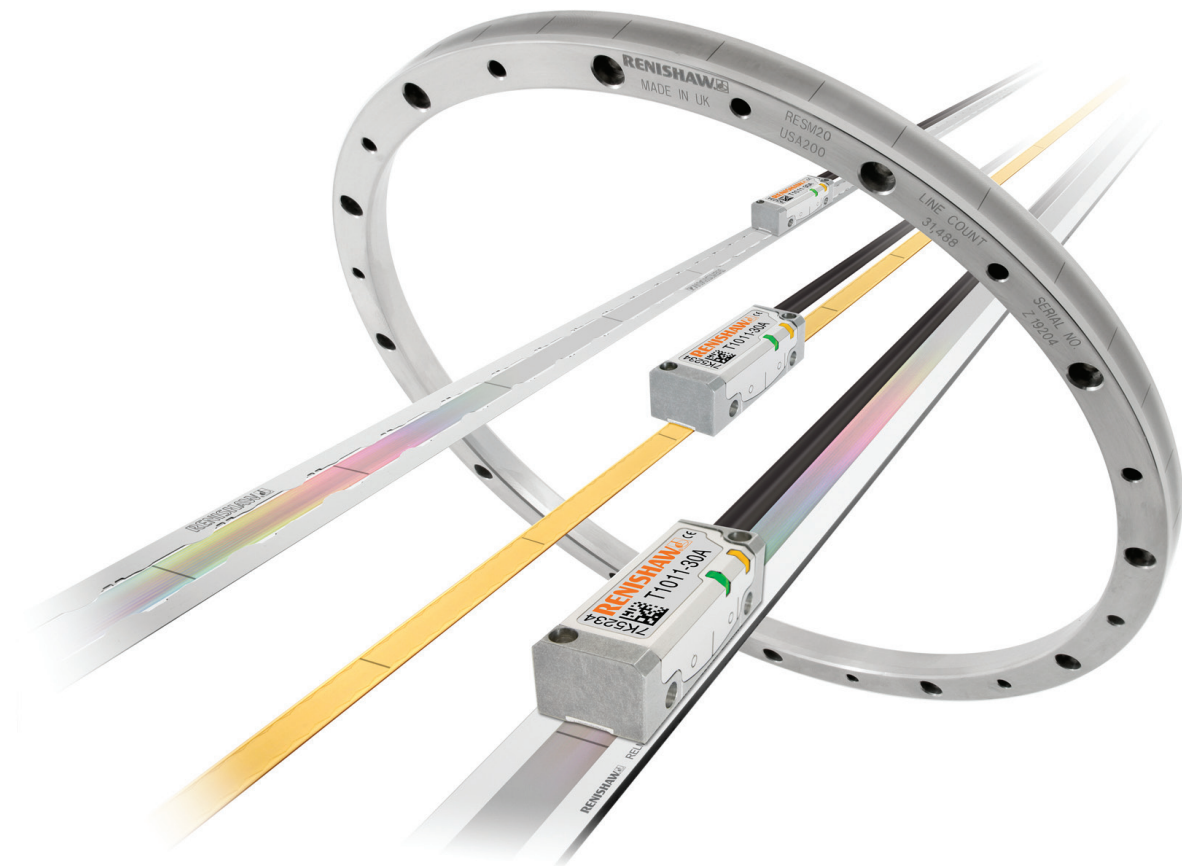


TONiC™ encoder system



Renishaw's **TONiC** series represents a new generation of super-compact encoders, designed for highly-dynamic precision motion systems, bringing higher accuracy, speed and greater reliability to a wide variety of demanding industry sectors.

The readhead is complemented by the latest evolution of RGSZ20 gold tape scale, REXM ultra-high accuracy angle encoder and *FASTRACK*™/RTLC scale system with bi-directional optical *IN-TRAC*™ reference marks, in addition to established RSLM stainless steel scale, RELM high accuracy invar scale and RESM rotary rings.

For ultimate reliability and high dirt immunity, **TONiC** readheads incorporate third-generation filtering optics, tuned for even lower noise (jitter), further enhanced by dynamic signal processing including Auto Gain Control and Auto Offset Control. The result is low sub-divisional error (SDE) giving smoother velocity control for improved scanning performance and increased positional stability.

TONiC readheads also feature a detachable analogue or digital interface in the form of a robust, convenient connector that can be located up to 10 m from the readhead.

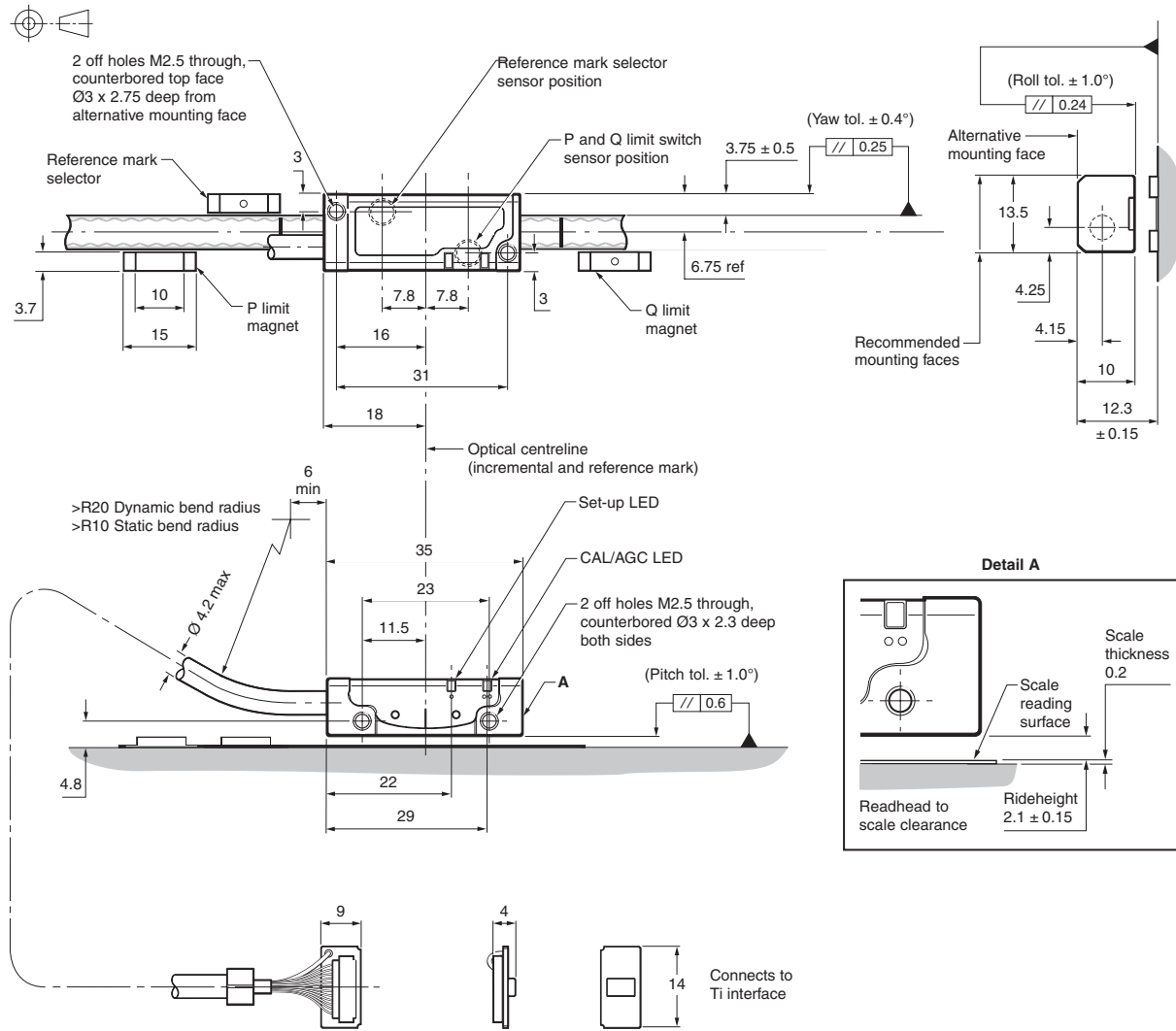
The interface offers digital interpolation to 1 nm resolution, with clocked outputs for optimised speed performance at all resolutions for industry-standard controllers.

- Compact readhead (35 x 13.5 x 10 mm)
- Compatible with RGSZ20 gold tape scale, *FASTRACK*/RTLC scale system RSLM, RELM, RESM and REXM with customer-selectable *IN-TRAC* auto-phase optical reference mark (datum)
- Third-generation filtering optics optimised for even lower noise (jitter)
- Dynamic signal processing inside the readhead, provides ultra-low cyclic error of ± 30 nm
- Auto Gain Control ensures consistent signal strength for long-term reliability
- Increased ride height tolerance and patented set-up LED for ease of installation
- Maximum speed to 10 m/s (3.24 m/s at 0.1 μ m resolution)
- Detachable analogue or digital connector with integral interpolation to 1 nm resolution (0.00075 arc seconds)
- Integral dual limits (linear only)
- Operating temperature to 70 °C



TONiC readhead installation drawing

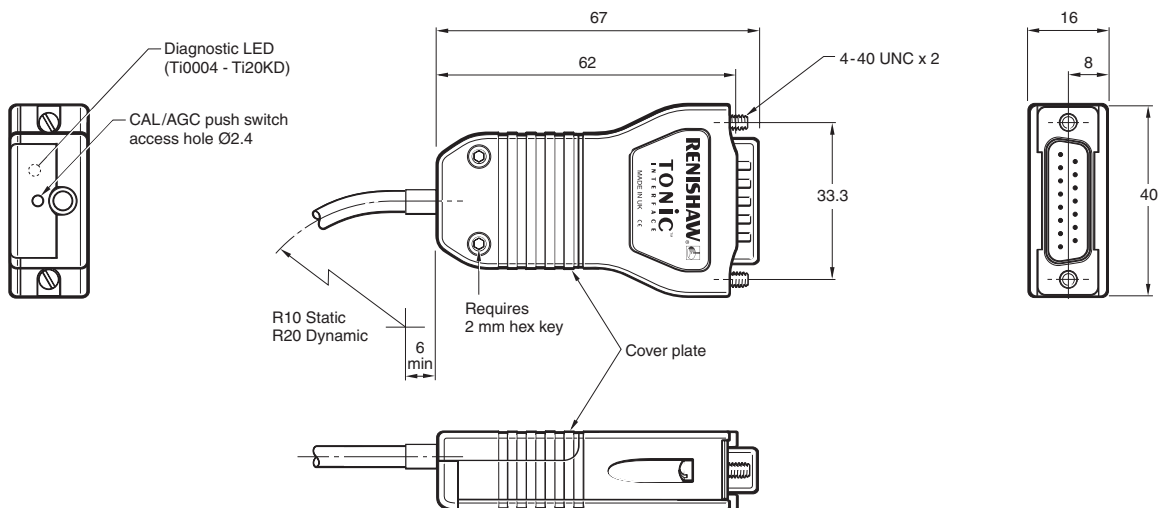
Dimensions and tolerances in mm




NOTE: RGSZ20 only shown.

For detailed installation drawings, refer to **TONiC** T100x RGSZ (M-9653-9154), **TONiC** T101x RSLM/RELM (M-9653-9225), **TONiC** T20x1 RESM (M-9653-9161), **TONiC** T20x1 RESD (M-9676-9000), **TONiC** T103x RTLC (M-9589-9002) and **TONiC** T20x1 REXM (M-9653-9248) Installation guides. Refer to RGSZ20 (L-9517-9348), RELM (L-9517-9219), RSLM (L-9517-9305), RESM (L-9517-9154), RESD (L-9517-9375) and REXM (L-9517-9318) Data sheets for scale information.

Ti interface dimension drawing



Operating and electrical specifications

Power supply	5V ±10%	T1xxx/2xxx + Ti0000 <100 mA T1xxx/2xxx + Ti0004 - Ti20KD <200 mA NOTE: Current consumption figures refer to unterminated systems. For digital outputs, a further 25 mA per channel pair (eg A+, A-) will be drawn when terminated with 120 Ω. For analogue outputs, a further 20 mA will be drawn when terminated with 120 Ω. Power from a 5 V dc supply complying with the requirements for SELV of standard EN (IEC) 60950.
	Ripple	200 mVpp maximum @ frequency up to 500 kHz
Temperature (system) (readhead) (interface)	Storage	-20 °C to +70 °C
	Operating	0 °C to +70 °C
	Operating	0 °C to +70 °C
Humidity	Storage	95% maximum relative humidity (non-condensing)
	Operating	80% maximum relative humidity (non-condensing)
Sealing (readhead) (interface)		IP40
		IP20
Acceleration (readhead)	Operating	500 m/s ² BS EN 60068-2-7:1993 (IEC 68-2-7:1983)
Shock (system)	Non-operating	1000 m/s ² , 6 ms, ½ sine BS EN 60068-2-27:1993 (IEC 68-2-27:1987)
Vibration (system)	Operating	100 m/s ² max @ 55 Hz to 2000 Hz BS EN 60068-2-6:1996 (IEC 68-2-6:1995)
Mass	Readhead	10 g
	Interface	100 g
	Cable	26 g/m
EMC compliance (system)	BS EN 61326-1: 2006	
Environmental	Compliant with EU Directive 2002/95/EC (RoHS)	
Readhead cable	Double-shielded, outside diameter 4.2 mm maximum Flex life >20 x 10 ⁶ cycles at 20 mm bend radius UL recognised component 	

NOTE: Class 1 LED product. Invisible LED radiation.

Speed

Minimum receiver clock frequency (MHz)	Maximum speed (m/s)										
	Ti0004 5 µm	Ti0020 1 µm	Ti0040 0.5 µm	Ti0100 0.2 µm	Ti0200 0.1 µm	Ti0400 50 nm	Ti1000 20 nm	Ti2000 10 nm	Ti4000 5 nm	Ti10KD 2 nm	Ti20KD 1 nm
50	10	10	10	6.48	3.240	1.625	0.648	0.324	0.162	0.065	0.032
40	10	10	10	5.40	2.700	1.350	0.540	0.270	0.135	0.054	0.027
25	10	10	8.10	3.24	1.620	0.810	0.324	0.162	0.081	0.032	0.016
20	10	10	6.75	2.70	1.350	0.670	0.270	0.135	0.068	0.027	0.013
12	10	9	4.50	1.80	0.900	0.450	0.180	0.090	0.045	0.018	0.009
10	10	8.10	4.00	1.62	0.810	0.400	0.162	0.081	0.041	0.016	0.0081
8	10	6.48	3.24	1.29	0.648	0.324	0.130	0.065	0.032	0.013	0.0065
6	10	4.50	2.25	0.90	0.450	0.225	0.090	0.045	0.023	0.009	0.0045
4	10	3.37	1.68	0.67	0.338	0.169	0.068	0.034	0.017	0.0068	0.0034
1	4.2	0.84	0.42	0.16	0.084	0.042	0.017	0.008	0.004	0.0017	0.0008
Analogue output	10 (-3dB)										

Angular speed depends on ring diameter - use the following equation to convert to rev/min.

$$\text{Angular speed (rev/min)} = \frac{V \times 1000 \times 60}{\pi D} \quad \text{Where } V = \text{maximum linear speed (m/s) and } D = \text{external diameter of RESM or REXM (mm)}$$

System features

Reference mark

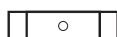
Form	<i>IN-TRAC</i> reference mark, directly in incremental track Refer to RGSZ, <i>FASTRACK</i> /RTLCL, RELM, RSLM, RESM or REXM Data sheets for reference mark location Bi-directionally repeatable across full speed and temperature range Electronically phased, requires no physical adjustment
Selection	T1xx0 : Single reference mark selection by magnetic actuator (A-9653-0143), customer positioned T1xx1 and T2xx1 : No selector required, all reference marks output
Repeatability	Unit of resolution repeatability, over full operating temperature and speed

Dual limit switches (linear systems only)

Form	Magnetic actuators for P and Q limit switches 10 mm P limit, North pole facing – A-9653-0138 10 mm Q limit, South pole facing – A-9653-0139 20 mm P limit, North pole facing – A-9653-0237 20 mm Q limit, South pole facing – A-9653-0238 50 mm P limit, North pole facing – A-9653-0235 50 mm Q limit, South pole facing – A-9653-0236
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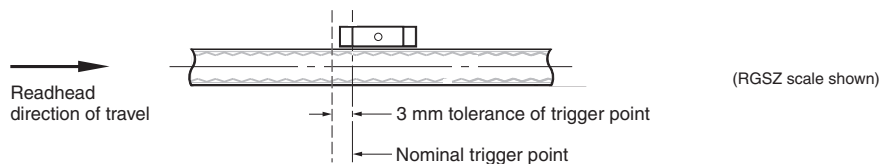
Typical P magnet



Typical Q magnet

Trigger point	Leading edge of magnet from direction of travel
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Trigger point tolerance



Mounting	Self-adhesive
Position	Customer placed at desired locations
Repeatability	<0.1 mm

Dynamic signal processing

Real time signal conditioning for optimized performance across a range of operating conditions

- Automatic Gain Control (AGC)
- Automatic Offset Control (AOC)

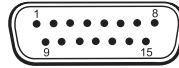
Ultra low cyclic error of ± 30 nm

Calibration

Simple calibration at the press of a button, no physical adjustment required

Optimization of incremental and reference mark signals

Connector pin configuration



15 pin 'D' type connector

Digital outputs

Function	Signal	Interface Ti0004-20KD	
		Signal	Pin
Power	5 V		7, 8
	0 V		2, 9
Incremental	A+		14
	A-		6
	B+		13
	B-		5
Reference mark	Z+		12
	Z-		4
Limits	P [†]		11
	Q		10
Set-up	X		1
Alarm [‡]	E-		3
Shield	Inner		*
	Outer		Case

Analogue outputs

Function	Signal	Readhead T1xxx/2xxx		Interface Ti0000	
		Colour	Pin	Colour	Pin
Power	5 V	Brown	4, 5		
	0 V	White	12, 13		
Incremental	Cosine	V ₁₊	Red	9	
		V ₁₋	Blue	1	
	Sine	V ₂₊	Yellow	10	
		V ₂₋	Green	2	
Reference mark	V ₀₊	Violet	3		
	V ₀₋	Grey	11		
Limits	V _p	Pink	7		
	V _q	Black	8		
Set-up	V _x	Clear	6		
Remote CAL	CAL	Orange	14		
Shield	Inner	Green/Yellow	*		
	Outer	Outer screen	Case		

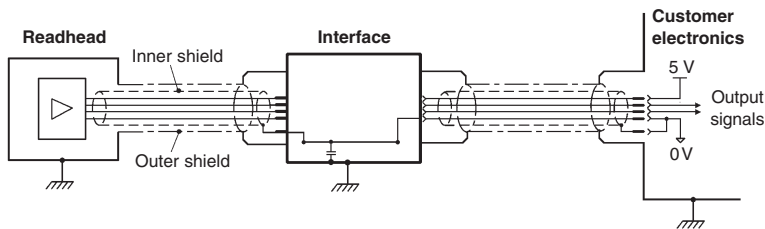
[†]Becomes alarm (E+) for options E, F, G, H

[‡]The alarm signal can be output as a line driver signal or 3-state. Please select the preferred option at time of ordering.

*Inner shield is connected to 0V inside the Ti interface

Electrical connections

Grounding and shielding



Maximum cable length

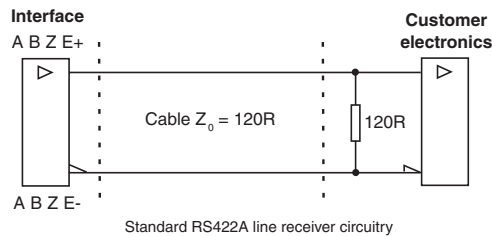
Readhead to interface: 10 m
Interface to controller: Dependent on output frequency. See table below for details.

Receiver clock frequency (MHz)	Maximum cable length (m)
40 to 50	25
<40	50
analogue	50

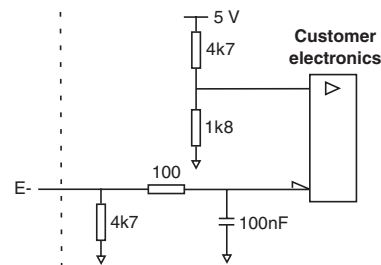
IMPORTANT: The outer shield should be connected to the machine earth (Field Ground). The inner shield should be connected to 0V at receiving electronics only. Care should be taken to ensure that the inner and outer shields are insulated from each other. If the inner and outer shields are connected together, this will cause a short between 0V and earth, which could cause electrical noise issues.

Recommended signal termination

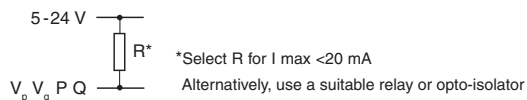
Digital outputs



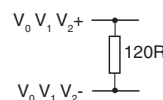
Single ended alarm signal termination (Options A, B, C, D)



Limit outputs



Analogue outputs



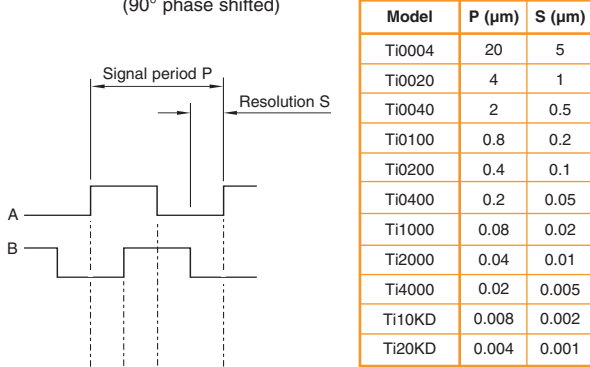
Output specifications

Digital output signals

- Interface models Ti0004 - Ti20KD

Form - Square wave differential line driver to EIA RS422A
 (except limits P and Q)

[†]Incremental 2 channels A and B in quadrature
 (90° phase shifted)



[†]Reference

Z — Synchronised pulse Z, duration as resolution

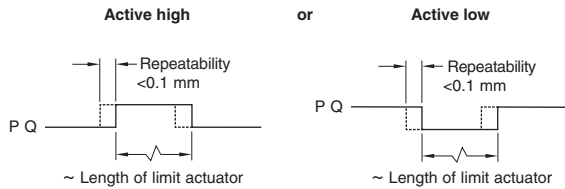
[†]Wide reference

Z — Synchronised pulse Z, duration as signal period

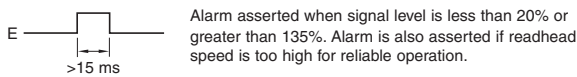
NOTE: Select 'standard' or 'wide' reference at time of ordering, to match the requirements of the controller being used.

Limits Open collector output, asynchronous pulse

Digital Ti0004 - Ti20KD only



[†]**Alarm** Asynchronous pulse

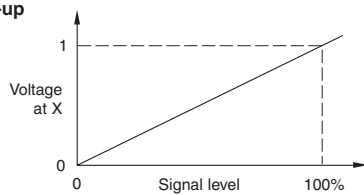


E- output only for options A, B, C, D

3-state alarm (option)

Differentially transmitted signals forced open circuit for >15 ms when alarm conditions valid.

*Set-up



Setup signal voltage proportional to incremental signal amplitude

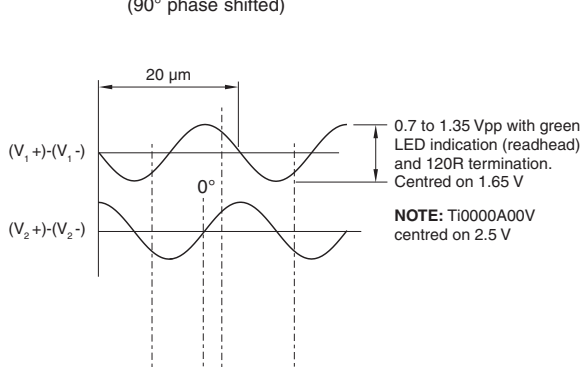
[†]**Note:** Inverse signals not shown for clarity

Analogue output signals

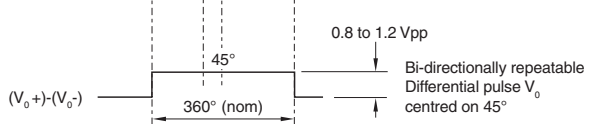
- Interface model Ti0000 and T1xxx/2xxx readhead

Note: Analogue signals are available direct from the T1000/T2000 readhead

Incremental 2 channels V_1 and V_2 differential sinusoids in quadrature
 (90° phase shifted)



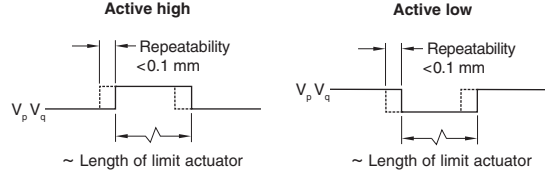
Reference



Limits Open collector output, asynchronous pulse

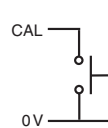
Ti0000 interface only

T1xxx readhead only



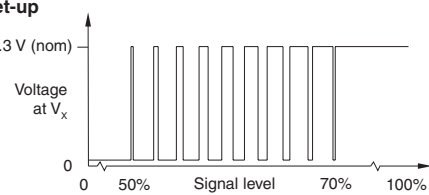
NOTE: Ti0000 interface contains a transistor to invert the readhead's 'active low' signal to give an 'active high' output.

Remote CAL operation (analogue versions only)



All Ti interfaces include a push button switch to enable CAL/AGC features.
 Remote operation of the CAL/AGC is possible via pin 14 of analogue Ti0000 interfaces.
 For applications where no Ti interface is used, remote operation of CAL/AGC is essential.

*Set-up

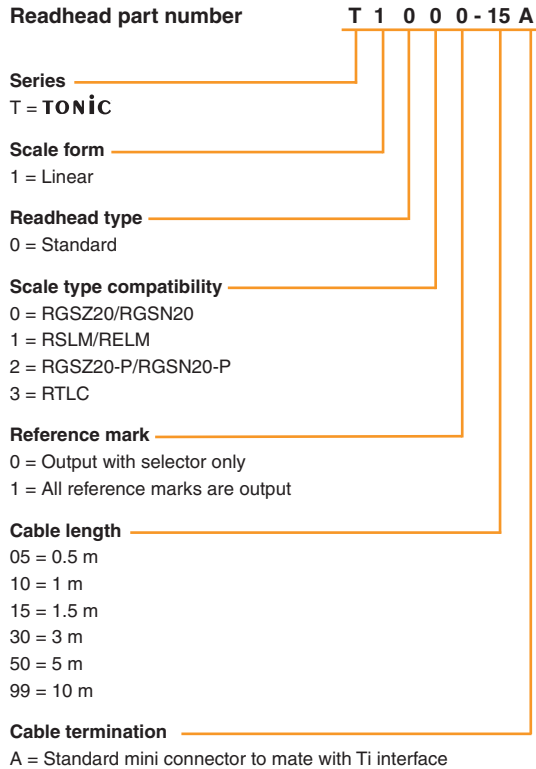


Between 50% and 70% signal level, V_x is a duty cycle, 20 µm duration. Time spent at 3.3 V increases with incremental signal level.
 At >70% signal level V_x is nominal 3.3 V.

*Set-up signals as shown are not present during calibration routine

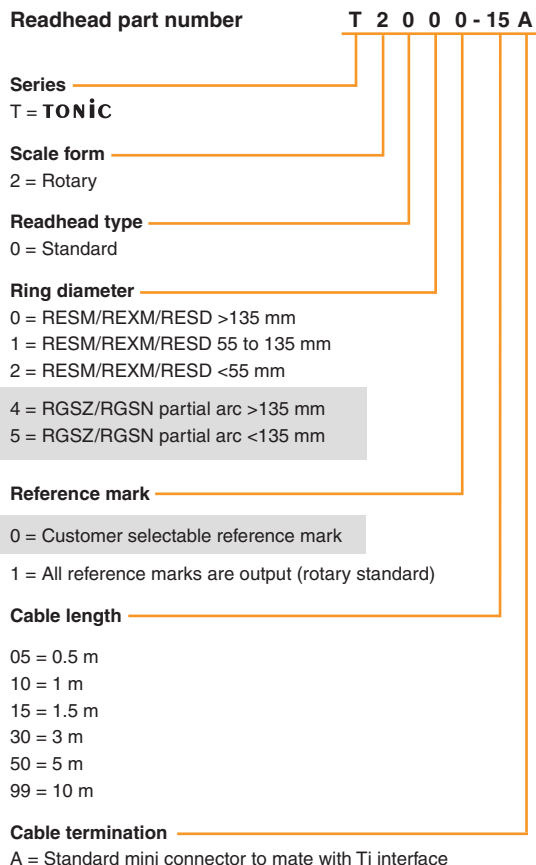
T1xxx linear readhead

Compatible with RGSZ20, RTLC, RSLM or RELM scale.



T2xxx rotary readhead

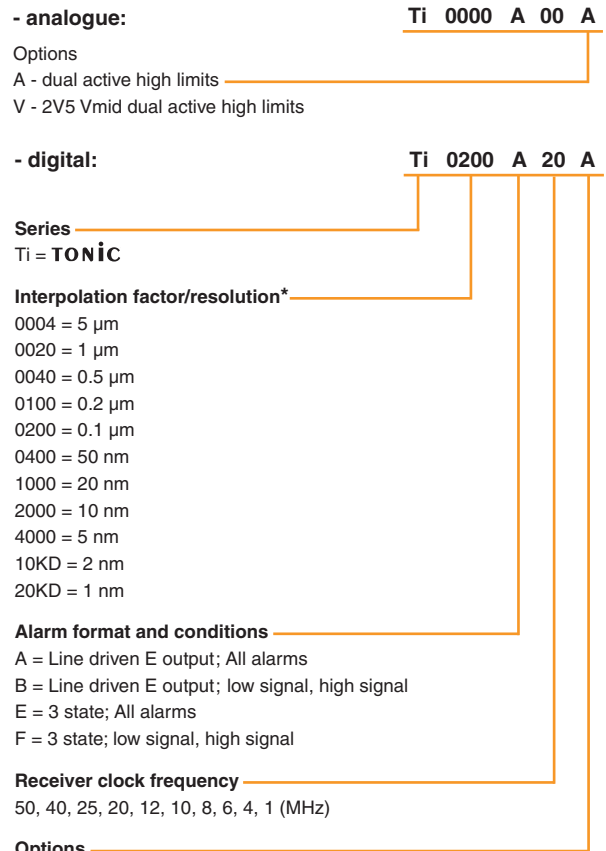
Compatible with RESM and REXM rings



Ti interface

Compatible with all **TONiC** readheads

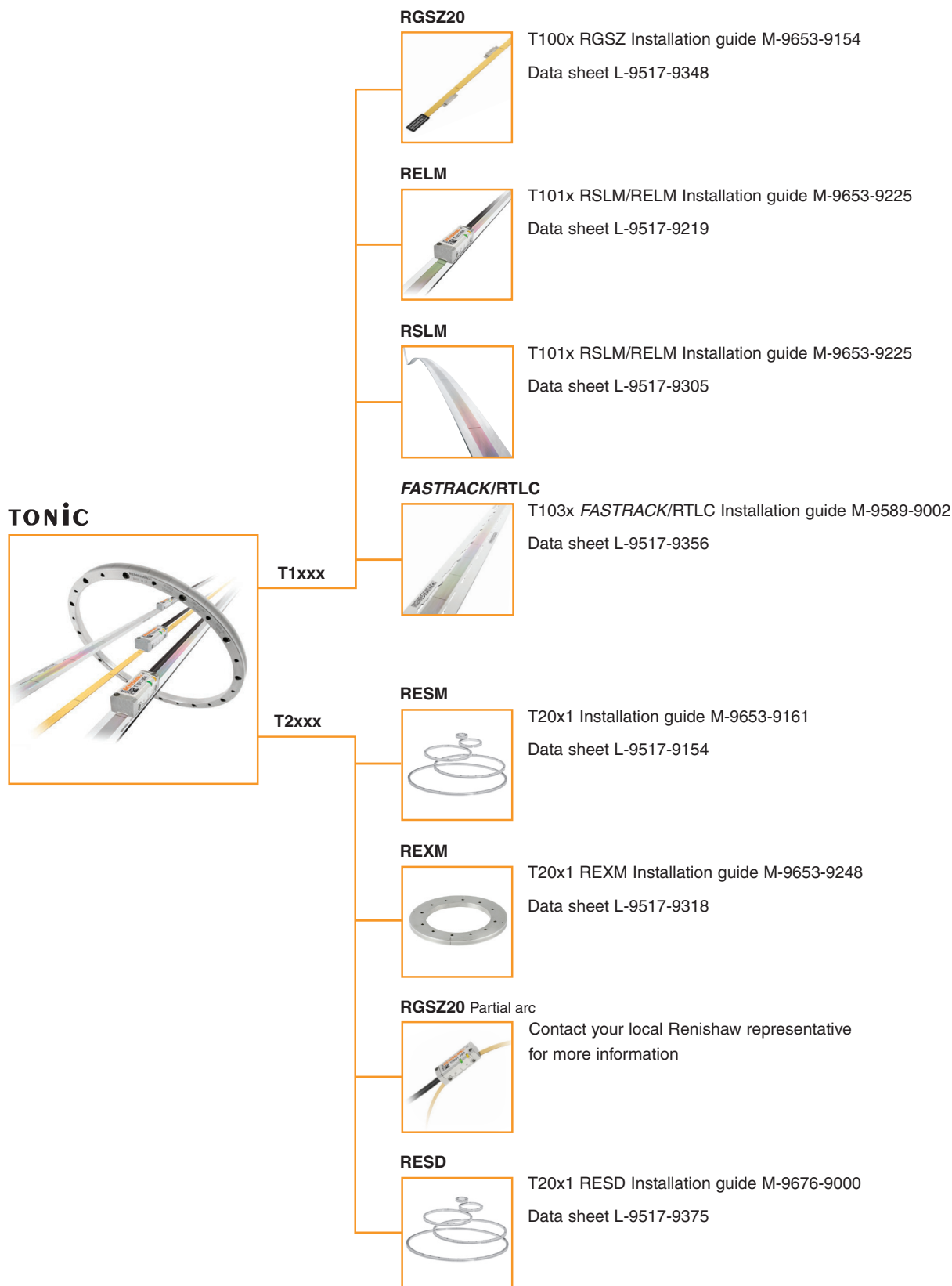
Interface part numbers



*Contact Renishaw for other interpolation factors.

Please contact your local Renishaw representative if you require a partial arc application

TONIC compatible products:



For worldwide contact details, please visit our main website at www.renishaw.com/contact

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